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# What's new in Spine Surgery

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## SPECIALTY UPDATE

# What's New in Spine Surgery

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### What's New in the Treatment of the Cervical Spine?

#### *Microendoscopic Decompression*

Posterior cervical microendoscopic decompression is a minimally invasive surgery performed using a tubular retractor and endoscopic camera or microscope. The purpose is to reduce muscle trauma compared with conventional approaches. The technique requires extensive training and there is a steep learning curve. Indications for the procedure are similar to those for traditional posterior cervical foraminotomy, which include posterolateral disc herniation and foraminal stenosis. One-year outcomes are similar to those reported for both standard foraminotomy and anterior discectomy and fusion. Durotomies occur in 1% to 4% of cases, greater than the rate for traditional foraminotomy. Further research is needed to determine the role of minimally invasive foraminotomy as clinical benefits are not apparent at this time.

#### *Patient Satisfaction*

Patients' satisfaction with their physicians and care process is becoming increasingly important and may not be under the complete control of the practitioner. Abnormal affective disorders are frequently present in patients with spinal conditions and are associated with overall lower patient satisfaction survey results. Interestingly, successful patient-reported outcomes are not correlated with patient satisfaction. Factors such as smoking, lower-level educational status, and younger age are associated with lower satisfaction. Specific provider factors associated with patient satisfaction are explanation of their condition, perception of empathy, and recognition of coordinated teamwork.

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#### *AO Myelopathy Study*

AOSpine North America performed a multi-institutional observational study of 264 patients with cervical spondylotic myelopathy. In addition, 366 international patients were enrolled separately. Approximately two-thirds were treated anteriorly, and one-third was treated with a posterior approach. After adjusting for differences in baseline, no outcome differences were present between the treatment groups; both groups improved. In North America, the predictors of outcome are age, severity of impairment, smoking status, gait abnormalities, psychological comorbidities, and baseline spinal cord cross-sectional area. In the international study, patients in Asia and Latin America were younger than patients in North America, and more patients in Asia had ossification of the posterior longitudinal ligament. The effect of psychological comorbidities on the prediction of outcomes was absent outside of North America. Risk factors for complications were older age; comorbidities such as obesity, diabetes, and gastrointestinal disorders; and two-stage or complex procedures.

#### *Fusion*

The Cervical Spine Research Society performed a systematic literature review to determine the best method that defines radiographic fusion success. The best first screening method is to measure the interspinous process tip distance and to compare flexion with extension radiographs. A healed fusion has a  $\leq 1$ -mm difference between the dynamic images. If further evaluation is needed, then computed tomography (CT) is recommended.

#### *Complications*

Dysphagia is the most common long-term complication after anterior discectomy and fusion. Application of triamcinolone

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## WHAT'S NEW IN SPINE SURGERY

and, more recently, Depo-Medrol (methylprednisolone) to a collagen sponge placed in the retropharyngeal space has been associated with significantly less dysphagia. No adverse effect on fusion or esophageal perforation has been reported, although the studies are underpowered to evaluate this. Other methods to reduce dysphagia are to have patients perform preoperative stretching of the esophagus and trachea, to reduce retraction time, to avoid the use of bone morphogenetic protein (BMP), to use lower-profile and smoother plates, and to decrease endotracheal cuff pressure. Not surprisingly, postoperative dysphagia is associated with abnormal baseline psychological factors.

The National Surgical Quality Improvement Program (NSQIP) is a quality improvement program that can be used to identify specific complications and potential risk factors. Using these data, anterior cervical procedures were associated with a significantly lower prevalence of surgical site infection than posterior procedures. Risk factors for surgical site infection are a patient body mass index of  $>35 \text{ kg/m}^2$ , operative times over three hours, and chronic corticosteroid use. The use of intra-wound vancomycin in case-controlled studies has been shown to decrease surgical site infection by 63% to 89% compared with historical controls. However, the study design is inadequate to determine the true effect because of confounding variables.

### Deformity

A method to measure the horizontal translation of the head and neck is the horizontal offset difference between the sagittal vertebral axis of C2 and that of C7 (C2-C7 sagittal vertebral axis). This represents the amount of anterior translation of the head relative to the thorax. The presence of a large C2-C7 sagittal vertebral axis value results in neck pain and trapezial spasm, as the trapezius is recruited to attempt to correct deformity. An increased C2-C7 sagittal vertebral axis is associated with a higher risk of adjacent segment degeneration and increased pain following laminoplasty.

## What's New in Biologics for the Spine?

### Recombinant Osteoinductive Proteins

In 2014, there was a continued focus around potential local and systemic adverse effects associated with recombinant human bone morphogenetic protein-2 (rhBMP-2) (Infuse; Medtronic, Memphis, Tennessee), with an emphasis on more studies that suggest complication rates may not be as high as originally reported in 2011. Recent North American Spine Society guidelines have taken a strongly conservative position on rhBMP-2, but the recent *Journal of Neurosurgery: Spine* guidelines support rhBMP-2 as a viable option as a substitute for iliac crest bone graft alone or when combined with calcium phosphate extenders or local bone graft. Cost-effectiveness and cost-utility studies of rhBMP-2 to date have been discordant, and the result will likely vary on the basis of the specific clinical situation (multilevel, impaired host, or posterolateral).

Because serious side effects, such as cancer, are so rare, authors have resorted to "big data" to shed more light on this issue. The Yale Open Data Access studies published in 2013, which independently reviewed the pooled clinical trial data, were discordant on the issue of whether rhBMP-2 increased cancer risk. A Medicare database study suggested that rhBMP-2 was associated with a slightly lower risk of cancer. A recent study using the MarketScan Database analyzing 52,000 patients from 2006 to 2010 showed that utilization of BMP-2 was associated with a slightly lower risk of cancer (odds ratio, 0.92) and a slightly increased risk of complications (15.8% compared with 14.9%) in multilevel fusions, but decreased rates of infection and wound dehiscence.

A meta-analysis of eight randomized controlled trials showed that rhBMP-2 resulted in decreased risk of nonunion, decreased operating room time, decreased bleeding, and decreased risk of reoperation. A decreased risk of reoperation with rhBMP-2 was also reported in a review of the Kaiser Permanente database of more than 9000 patients undergoing fusion. Another analysis using the MarketScan Database reviewed 61,000 cervical spine fusions (2002-2009), including 1677 that used rhBMP-2, and concluded that there was a substantially higher complication (odds ratio, 1.29) and reoperation rate in the cases that used rhBMP-2. Some surgeons have reported good results with rhBMP-2 in multilevel cervical fusions with lower doses than originally reported.

Deformity is an area in which the use of Infuse can yield a major improvement in fusion success. rhBMP-2 has been reported to be used in 10% to 38% of pediatric spine fusions. The rate of complications was not increased with use of rhBMP-2 in this patient population. A prospective multicenter trial involving adult spinal deformity reported on the use of rhBMP-2 (2.5 mg/level posteriorly and 50 mg/level interbody). rhBMP-2 was used in larger, more complicated cases, but multivariate analysis showed no increase in complications.

### Other Bone Graft Substitutes

A review of a large national database showed that iliac crest bone graft was used in only 6% of nearly 14,000 spine fusions, was 1.5 times more likely to result in blood transfusions, and was associated with increases in operative time (twenty-two minutes) and length of stay (0.2 day). Mineralized collagen matrix (Healos; DePuy Spine, Raynham, Massachusetts) with bone marrow was shown to perform worse than local bone graft in posterolateral spine fusion. Silicate-substituted calcium phosphate (Actifuse; ApaTech, Foxborough, Massachusetts) was shown to perform much worse than rhBMP-2 in a minimally invasive transforaminal lumbar interbody fusion study. Cellular-based matrices are now estimated to be used in 15% of spine fusions and are likely safe, but minimal efficacy data are available for these minimally manipulated tissues.

### Biologic Treatments for Disc Degeneration

Progress toward biologic treatments to prevent or to retard disc degeneration continues. There are continued efforts at

## WHAT'S NEW IN SPINE SURGERY

injecting mesenchymal stem cells and platelet-rich plasma into the intervertebral disc of animals and humans. It is unclear if these cells are intended to participate directly in disc regeneration or to provide stimulating growth factors. Most of the studies in the past year have been in vitro proof-of-concept studies, which are difficult to translate into the in vivo setting, making this a rewarding but challenging area.

### What's New in Spinal Deformity Surgery?

There were 129 podium and 103 poster presentations at the Scoliosis Research Society (SRS) 49th Annual Meeting & Course held from September 10 to 13, 2014, in Anchorage, Alaska.

#### Adolescent Idiopathic Scoliosis

The National Institutes of Health (NIH) prospective randomized controlled trial, Bracing in Adolescent Idiopathic Scoliosis Trial (BrAIST), on the efficacy of bracing for adolescent idiopathic scoliosis, demonstrated worse quality of life in patients whose curves progress to  $>50^\circ$  despite brace wear. In addition, it appears that many patients are at low risk for significant progression with or without brace wear. Although the trial clearly demonstrated the effectiveness of braces, those who did not benefit from bracing were skeletally immature and presented with high Cobb angles.

Distal fusion level selection at L3 or L4 was a hot topic for lumbar curves in patients with adolescent idiopathic scoliosis. Cohort studies demonstrated similar outcomes regardless of the lowest instrumented vertebrae at the five-year follow-up. Interestingly, there was also no difference in degeneration at the caudal levels according to the lowest instrumented vertebrae at a mean follow-up of seven years.

There is increasing attention being focused on reciprocal changes in the adjacent regional segments of the spine after fusions for adolescent idiopathic scoliosis. Specifically, cervical spine alignment was noted to become more kyphotic with postoperative thoracic hypokyphosis. The long-term significance of this is not known.

The utility of magnetic resonance imaging (MRI) as a screening tool prior to adolescent idiopathic scoliosis surgery continues to be questioned. One study of more than 1100 patients demonstrated no difference in the incidence of neural axis abnormalities in curves of  $\geq 80^\circ$  or  $<80^\circ$ . This indicates that acquiring MRI preoperatively in the presence of a large curve alone may not be necessary.

#### Adult Spinal Deformity

Work from the European Spine Study Group compared the disease burden of adult spinal deformity to that of other chronic diseases and concluded that spinal deformity was as disabling as, if not more disabling than, other chronic diseases.

Continued work from the International Spine Study Group demonstrated superior outcomes at a minimum two-

year follow-up for patients who underwent operative intervention for adult spinal deformity compared with nonoperative controls.

The use of BMP in this patient population was investigated again with great interest. BMP was associated with fewer overall complications and lower rates of revision surgery without any associated increase in cancer risk at the 3.5-year follow-up. Even at higher doses ( $>40$  mg), there was no increased rate of new cancers or recurrence of prior cancers seen in the cohort. The overall prevalence of cancer was also not noted to be higher than that reported by the National Cancer Institute. One study suggested reevaluating the economics of BMP use, stating that their findings of a 7.5-fold decrease in reoperation rates when BMP was used may justify its use.

#### Neuromuscular Scoliosis

Infection continues to be an important concern in the surgical treatment of neuromuscular scoliosis. In addition, a study from the SRS Morbidity and Mortality (M&M) Database revealed these cases to have the highest rates of mortality and infection.

#### Early Onset Scoliosis

Preliminary data on vertebral body tethering for the treatment of early onset scoliosis were reported with a two-year follow-up. There were eleven patients in the study and a significant correction of their deformity from  $44^\circ$  to  $13.5^\circ$  was noted using the tether. Two of the eleven patients needed to have a revision operation to release the tether to avoid overcorrection. It appears that larger studies will be needed to identify those who are the best candidates for this operation.

#### Congenital Scoliosis

Data comparing patients with congenital scoliosis who underwent early fusion (at a mean of 5.7 years of age) and late fusion (at 13.8 years of age) demonstrated that early fusions had higher rates of revision operations at a mean follow-up of fifteen years, despite no differences in preoperative curve severity. These findings question early operative intervention compared with close observation in younger patients with congenital scoliosis.

#### Basic Science

Strong data from a rat model questioned the need for systemic intravenous antibiotic therapy when topical operative-site antibiotics were used. In that study, a total of sixty rats were given various intravenous antibiotics or a topical local antibiotic powder application to a surgical site implanted with a GORE-TEX (W.L. Gore & Associates, Newark, Delaware) graft and methicillin-sensitive *Staphylococcus aureus* (MSSA). One week later, the GORE-TEX grafts were retrieved and were cultured; 100% of the rats receiving intravenous antibiotics had positive cultures for MSSA, and 0% of

## WHAT'S NEW IN SPINE SURGERY

the rats receiving the local vancomycin powder had positive cultures.

### What's New in the Treatment of Spinal Cord Injury?

Multiple clinical trials for the pharmacologic treatment of spinal cord injury are ongoing in various phases, including neuroprotective and neuroregenerative strategies. Meanwhile, enthusiasm for steroid treatment for acute spinal cord injuries appears to have waned among spine surgeons in recent years. Acute treatment of spinal cord injury with regard to mean arterial pressure and time until surgery has also been recently presented.

In a survey of eighty-four surgeon members of the Cervical Spine Research Society regarding patients with acute spinal cord injuries, of the surgeons who reported giving corticosteroids, 47.4% gave them for complete injuries, 56.4% gave them for incomplete spinal cord injuries, 46.2% gave them for complete thoracolumbar injuries, and 55.1% gave them for incomplete injuries. This is a significant decrease compared with 89% of surgeons who had reported giving corticosteroids in a previous study in 2006. Potential complications were the main reason for not using corticosteroids. Of those who used corticosteroids, 26% thought that they improved recovery, 19.2% stated that they were adhering to institutional protocol, and 25.6% did not think that they were beneficial, but prescribed on the basis of medicolegal concerns.

Since completion of the phase-I study, which demonstrated the safety of riluzole for acute spinal cord injury, subject enrollment for the phase-II/III study began in October 2013. The study will evaluate superiority of riluzole compared with placebo when given for acute spinal cord injury within the first twelve hours and continued for thirteen days after injury with a primary outcome of the American Spinal Injury Association (ASIA) Motor Score. The study will recruit 351 patients with acute C4-C8 spinal cord injury.

The Miami Project to Cure Paralysis currently has five clinical trials regarding spinal cord injury approved by the U.S. FDA (Food and Drug Administration). The phase-I safety trial evaluating autologous human Schwann cells in subacute injuries began in November 2012 and has been administered in three patients. Patients with traumatic spinal cord injury between T3 and T11 with complete injuries are eligible. The first two patients received a dose of 5 million cells and the third patient received a dose of 10 million cells, with no treatment-related adverse events. This safety trial is actively recruiting five more participants. The FDA has also approved testing of one subject for the efficacy of adult mesenchymal stem cells.

In a randomized, prospective, double-blind study, olfactory ensheathing cells with or without Schwann cells were used to treat chronic complete spinal cord injuries. At the six-month follow-up, in the five patients treated with olfactory ensheathing cells, Schwann cells, or a combination of the two,

results showed improvements in functional tests and all but one patient had improvements in electrophysiological tests. A larger study is likely needed to further evaluate the results of this small trial.

The study of minocycline in acute spinal cord injury is currently recruiting participants for a phase-III clinical trial. The phase-II randomized trial demonstrated safety, as well as a tendency toward improved outcomes. In the phase-III trial, intravenous minocycline is given twice daily (800-mg initial dose, tapered to 400 mg for seven days) within twelve hours of the injury. The trial began enrolling patients in June 2013 and is scheduled to be complete in June 2018.

The treatment of mean arterial pressure in patients with spinal cord injury prior to surgery was recently evaluated and was presented. In that study, mean arterial pressures were measured throughout initial hospitalization prior to transfer, throughout the transfer process, and in the final treating hospital. Prior to transfer, the mean arterial pressure was reported to be below 80 mm Hg in 51% of the recorded times and below 70 mm Hg in 40% of the times. During transfer, 31% of readings were below 80 mm Hg and 17% were below 70 mm Hg, and while waiting for surgery in the specialist hospital, 49% of readings were below 80 mm Hg and 20% were below 70 mm Hg. The study also evaluated the effects of vasopressors on spinal cord perfusion pressures by placing a lumbar intrathecal catheter caudal to the injury site at the time of surgery. The authors found an increase in intrathecal pressure when the patients' medication was changed from norepinephrine to dopamine, suggesting that norepinephrine may lead to improved spinal cord perfusion (the difference between the mean arterial pressure and intrathecal pressure).

In a study of 949 patients with traumatic spinal cord injury in the Rick Hansen National Spinal Cord Injury Registry between 2004 and 2013, the time to surgery was evaluated with regard to admitting and postoperative neurological status. The time until surgery demonstrated no effect on patients with an ASIA Injury Scale (AIS) A injury at admission. However, patients with AIS B, C, or D injuries increased their motor score by nearly 7 points when surgery was performed within twenty-four hours, suggesting that early decompression is beneficial for patients with incomplete injuries.

### What's New in the Treatment of the Lumbar Spine?

There are a number of new research studies that have demonstrated important advances in the treatment of the lumbar spine.

#### *Intrawound Antibiotics*

A recent study looked at osteoblasts taken from five patients during spinal fusion surgery and grown in cell culture to examine the effect of intrawound vancomycin. These cells were exposed to three different doses of vancomycin at



## WHAT'S NEW IN SPINE SURGERY

concentrations of 3, 6, or 12 mg/cm<sup>2</sup>. Bone samples from all five patients showed emigration of osteoblasts after three to six days. However, after the addition of vancomycin, emigrated osteoblasts were only visible in one of the five samples regardless of concentration. The mean cell viability was 100% in the group with the lowest dosage of vancomycin, only 97% in the group with the second-highest dosage of vancomycin, and 84% in the group with the highest dosage of vancomycin, which was highly significant ( $p < 0.009$ ). The authors concluded that the application of vancomycin led to dose-dependent inhibition of cell migration, cell proliferation, and viability, and to severe morphological changes. This certainly could affect the union rate after spinal fusion in which vancomycin is applied in the wound.

**Sacroiliac Joint Issues**

A recent study looked at the prevalence of sacroiliac joint degeneration in the asymptomatic population. The authors looked at 500 patients who underwent abdominal and pelvic CT scans for reasons other than low back or pelvic girdle pain, and 373 patients were included in the study. A total of 746 sacroiliac joints were included. The overall prevalence of degeneration in at least one sacroiliac joint was 131 (35%) and the overall prevalence of significant degeneration in at least one joint was 114 (31%). This prevalence increased with each decade of life from the second decade to the eighth decade. The authors concluded that degenerative changes in the sacroiliac joints are prevalent in the asymptomatic population and are increasingly common with increasing age. The presence of degenerative changes on imaging studies did not correlate with symptoms.

**Socioeconomics**

A recent study looked at the use of cell saver autotransfusion for short-segment lumbar spinal fusion surgery in 508 patients undergoing lumbar laminectomy and fusion for three or fewer levels from their prospective spinal outcomes registry. Of these patients, eighty-four (16.5%) had a cell saver setup for surgery and sixty-five (77%) of the eighty-four patients received cell saver transfusions. In the same group of 508 patients, fifty-seven patients without cell saver required allogeneic transfusions. The authors found that cell saver autologous transfusion was not cost-saving at their institution for patients undergoing three or fewer levels of spinal laminectomy and fusion.

A group of authors sought to determine if there were any associations between patient demographic characteristics or outcomes and loss to follow-up one year after spine surgery. The authors entered all patients undergoing degenerative elective spine surgery over a two-year period in a registry. A total of 1484 patients were included in this study and had baseline and three-month outcomes available. Of this group, 233 (15.7%) were lost to follow-up at the one-year point. There were no differences in baseline demographic characteristics or

comorbidities of patients who had follow-up at one year compared with those who did not, with the exception of age and employment status. The patients lost to follow-up were significantly younger ( $p < 0.001$ ) at fifty-one years of age compared with 57.1 years of age for patients who were not lost to follow-up, and there was a significantly higher proportion ( $p = 0.04$ ) of preoperative employment for patients lost to follow-up (45.9%) compared with patients not lost to follow-up (41.7%). Preoperative pain, disability, and quality of life were similar between the two groups ( $p > 0.05$ ). There was no difference in ninety-day morbidity or three-month pain, disability, quality of life, and patient satisfaction between the two groups. In the multivariate analysis model, younger age ( $p < 0.001$ ) was the only independent predictor of loss to follow-up at one year. Thus, in a real-world registry of patients undergoing spine surgery, one-year loss to follow-up was about 15% and the only independent predictor of loss to follow-up in this degenerative spine population was younger age. Patients lost to follow-up were not those with worse outcomes or increased dissatisfaction.

**Upcoming Meetings and Events Related to Spine Surgery**

- The EUROSPINE Annual Meeting will be held September 2 through 4, 2015, in Copenhagen, Denmark. Web site: [www.eurospine.org](http://www.eurospine.org)
- The Scoliosis Research Society (SRS) 50th Annual Meeting will be held September 30 through October 3, 2015, in Minneapolis, Minnesota. Web site: [www.srs.org](http://www.srs.org)
- The North American Spine Society (NASS) Annual Meeting will be held October 14 through 17, 2015, in Chicago, Illinois. Web site: [www.spine.org](http://www.spine.org)
- The Cervical Spine Research Society (CSRS) Annual Meeting will be held December 3 and 4, 2015, in San Diego, California. Web site: [www.csr.org](http://www.csr.org)
- The Federation of Spine Associations will present the spine program at Specialty Day at the Annual Meeting of the American Academy of Orthopaedic Surgeons (AAOS) on March 1, 2016, in Orlando, Florida. Web site: [www.aaos.org](http://www.aaos.org)
- The International Society for the Advancement of Spine Surgery (ISASS) 16th Annual Meeting will be held April 6 through 9, 2016, in Las Vegas, Nevada. Web site: [www.isass.org](http://www.isass.org)
- The International Society for the Study of the Lumbar Spine (ISSLS) Annual Meeting will be held May 16 through 20, 2016, in Singapore. Web site: [www.issls.org](http://www.issls.org)
- The International Meeting on Advanced Spine Techniques (IMAST) 23rd Annual Meeting will be held July 13 through 16, 2016, in Washington, DC. Web site: [www.srs.org](http://www.srs.org)

## WHAT'S NEW IN SPINE SURGERY

**Evidence-Based Orthopaedics**

The editorial staff of *The Journal* reviewed a large number of recently published research studies related to the musculoskeletal system that received a higher Level of Evidence grade. In addition to articles published previously in this journal or included in the Suggested Readings, twenty-one other articles with a higher Level of Evidence grade were identified that were relevant to spine orthopaedics. A list of those titles is appended to this review after the standard bibliography. We have provided a brief commentary about each of the articles to help guide your further reading, in an evidence-based fashion, in this subspecialty area.

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**Suggested Readings**

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## WHAT'S NEW IN SPINE SURGERY

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- 19.** Tetreault LA, Nouri A, Singh A, Fawcett M, Fehlings MG. Predictors of outcome in patients with cervical spondylotic myelopathy undergoing surgical treatment: a

survey of members from AOSpine International. *World Neurosurg.* 2014 Mar-Apr;81(3-4):623-33. Epub 2013 Sep 19.

- 20.** Veeravagu A, Cole TS, Jiang B, Ratliff JK, Gidwani RA. The use of bone morphogenetic protein in thoracolumbar spine procedures: analysis of the MarketScan longitudinal database. *Spine J.* 2014 Dec 1;14(12):2929-37. Epub 2014 May 16.

## Evidence-Based Articles

**Abdel Shaheed C, Maher CG, Williams KA, McLachlan AJ.** Interventions available over the counter and advice for acute low back pain: systematic review and meta-analysis. *J Pain.* 2014 Jan;15(1):2-15. Epub 2013 Oct 14.

There is limited evidence that nonsteroidal anti-inflammatory drugs, heat wrap, and rubefacients provide immediate pain relief for acute back pain and that bed rest and advice are both ineffective.

**Goz V, McCarthy I, Weinreb JH, Dallas K, Bendo JA, Lafage V, Errico TJ.** Venous thromboembolic events after spinal fusion: which patients are at high risk? *J Bone Joint Surg Am.* 2014 Jun 4;96(11):936-42. [Epub ahead of print].

Using the National Inpatient Sample database, the authors determined the prevalence and risk factors for venous thromboembolism in patients undergoing spine fusion. From 2001 to 2010, more than 700,000 patients were included, having an overall incidence of venous thromboembolism of 0.50%, of which 0.29% were deep venous thromboses and 0.24% were pulmonary emboli. Risk factors were typical of known factors including a hypercoagulability state, certain medical comorbidities, older age, and male sex.

**Hart R, Komzák M, Okál F, Náhlík D, Jajtner P, Puskeiler M.** Allograft alone versus allograft with bone marrow concentrate for the healing of the instrumented posterolateral lumbar fusion. *Spine J.* 2014 Jul 1;14(7):1318-24. Epub 2013 Dec 20.

This study was a prospective, randomized, controlled, blinded comparison of allograft alone with allograft plus bone marrow concentrate to accomplish spine fusion in the adult population with spondylolisthesis. The group that had autologous bone marrow concentrate had a higher percentage of patients with apparent fusion than the group that did not. However, both groups had very poor union rates. Apparently allograft by itself is a terrible option and allograft with bone marrow concentrate is a better, but still not very good, option.

**Holden J, Davidson M, O'Halloran PD.** Health coaching for low back pain: a systematic review of the literature. *Int J Clin Pract.* 2014 Aug;68(8):950-62. Epub 2014 Apr 22.

This systematic review concluded that there is no available literature to provide good evidence on the efficacy of health coaching on the treatment of subacute back pain. All included studies documented change; however, the content of counseling programs varied among studies and measures of treatment fidelity were not consistent, precluding definitive conclusions. The lack of uniform protocols and clear interventions makes studying this clinical issue difficult.

**Huang Z, Wan S, Ning L, Han S.** Is unilateral kyphoplasty as effective and safe as bilateral kyphoplasties for osteoporotic vertebral compression fractures? A meta-analysis. *Clin Orthop Relat Res.* 2014 Sep;472(9):2833-42. Epub 2014 Jun 26.

This meta-analysis, which included five studies and 253 patients, evaluated the superiority of unilateral compared with bilateral percutaneous kyphoplasty for the treatment of osteoporotic vertebral compression fractures. The authors evaluated the visual analog scale (VAS) for back pain, Oswestry Disability Index, complication rates, kyphosis angle, anterior vertebral body height restoration, and operative times. There were no differences between treatment methods except for a shorter operative time with unilateral approaches. The sample sizes of all included studies were small. The authors suggested that unilateral approaches be used because of shorter operative time and lower cost, but high-quality studies are needed to confirm these findings.

**Hurlbert RJ, Alexander D, Bailey S, Mahood J, Abraham E, McBroom R, Jodoin A, Fisher C.** rhBMP-2 for posterolateral instrumented lumbar fusion: a multicenter prospective randomized controlled trial. *Spine (Phila Pa 1976).* 2013 Dec 1;38(25):2139-48.

The authors demonstrated that the use of rhBMP-2 for instrumented posterolateral lumbar surgery significantly improved the chances of radiographic fusion compared with the use of autograft.

**Jee H, Lee JH, Park KD, Ahn J, Park Y.** Ultrasound-guided versus fluoroscopy-guided sacroiliac joint intra-articular injections in the noninflammatory sacroiliac joint dysfunction: a prospective, randomized, single-blinded study. *Arch Phys Med Rehabil.* 2014 Feb;95(2):330-7. Epub 2013 Oct 9.

This was a prospective randomized controlled trial comparing the short-term effects and safety of ultrasound-guided sacroiliac joint injections with fluoroscopy-guided sacroiliac joint injections in patients with noninflammatory sacroiliac joint issues. There were 120 patients enrolled and results were compared at two and twelve weeks following the procedure. Of the fifty-five ultrasound-guided injections, forty-eight (87.3%) were successful and seven (12.7%) missed. For the fluoroscopy-guided injections, 98.2% were accurate, and three cases of intravascular injections occurred. The function and pain relief were similar in both groups, making the ultrasound-guided approach just as effective as the fluoroscopy-guided approach, but the accuracy rate was lower.

**Khurana G, Jindal P, Sharma JP, Bansal KK.** Postoperative pain and long-term functional outcome after administration of gabapentin and pregabalin in patients undergoing spinal surgery. *Spine (Phila Pa 1976).* 2014 Mar 15;39(6):E363-8.

This was a prospective, double-blind, randomized controlled trial to evaluate and to compare the analgesic efficacy, adverse effects, and clinical utility of gabapentin and pregabalin in postoperative pain treatment, long-term functional outcome, and quality of life in a total of ninety patients undergoing lumbar discectomy surgery. One hour before surgery and every eight hours for seven days, group A received 300 mg of gabapentin, group B received 75 mg of pregabalin, and group C received one placebo dose. The patients receiving pregabalin consistently showed reduced static and dynamic pain intensity and required less rescue drugs throughout the postoperative period. The Prolo score and Oswestry Disability Index score were significantly different ( $p < 0.05$ ) between group B and group C at all time points. Preoperative pregabalin was associated with less pain intensity and improved functional outcomes three months after lumbar discectomy. This was followed by gabapentin and then placebo.

**Kim KT, Cho DC, Sung JK, Kim YB, Kang H, Song KS, Choi GJ.** Intraoperative systemic infusion of lidocaine reduces postoperative pain after lumbar surgery: a double-blinded, randomized, placebo-controlled clinical trial. *Spine J.* 2014 Aug 1;14(8):1559-66. Epub 2013 Nov 8.

This prospective, randomized, double-blinded trial evaluated the effects of intraoperative systemic lidocaine infusion on postoperative pain compared with a normal saline control infusion. Fifty-one patients underwent lumbar microdiscectomy by the same surgeon. The primary outcome measure was VAS pain at four hours after surgery. The VAS scores were significantly lower in the treatment group at all time points except at forty-eight hours after surgery. There were no adverse events associated with lidocaine infusion. The frequency of pushing the button of patient-controlled analgesia systems and total fentanyl administered were significantly lower in the lidocaine treatment group compared with controls. The length of hospital

## WHAT'S NEW IN SPINE SURGERY

stay was also significantly shorter in the lidocaine group (six days) compared with the control group (seven days).

**Manchikanti L, Benyamin RM, Falco FJE, Kaye AD, Hirsch JA.** Do epidural injections provide short- and long-term relief for lumbar disc herniation? A systematic review. *Clin Orthop Relat Res.* 2014 Feb 11. [Epub ahead of print].

This systematic review determined the efficacy in terms of pain relief and functional improvement of caudal, interlaminar, and interforaminal epidural injections using fluoroscopy for the treatment of disc herniations. Sixty-six studies were assessed using Cochrane review criteria, which left twenty-three randomized controlled trials for analysis. Pain relief was defined as at least 50% improvement or 3-point improvement in pain scores in at least 50% of patients. Functional improvement was defined as 50% reduction in disability or 30% reduction in disability scores. All epidural approaches had strong evidence for short-term relief (less than six months) and moderate evidence for long-term relief (six months or more). The heterogeneity of the trials did not allow pooled quantitative analysis of the studies, and future studies need to be appropriately designed with validated outcome parameters.

**McGregor AH, Probyn K, Cro S, Doré CJ, Burton AK, Balagué F, Pincus T, Fairbank J.** Rehabilitation following surgery for lumbar spinal stenosis. A Cochrane review. *Spine (Phila Pa 1976).* 2014 Jun 1;39(13):1044-54.

The authors found moderate-quality evidence indicating that postoperative active rehabilitation after decompression surgery for lumbar spinal stenosis is more cost-effective than the usual care.

**Nakashima H, Kato F, Yukawa Y, Imagama S, Ito K, Machino M, Ishiguro N.** Comparative effectiveness of open-door laminoplasty versus French-door laminoplasty in cervical compressive myelopathy. *Spine (Phila Pa 1976).* 2014 Apr 15;39(8):642-7.

In this prospective, randomized study, open-door laminoplasty was compared with French-door laminoplasty for cervical myelopathy. Ninety-two patients were studied. The two techniques demonstrated identical neurological recovery and perioperative complications. However, the patients who had undergone laminoplasty with the open-door technique had more cervical kyphosis and less cervical range of motion postoperatively than patients who had undergone laminoplasty with the French-door technique.

**Oosterhuis T, Costa LO, Maher CG, de Vet HC, van Tulder MW, Ostelo RW.** Rehabilitation after lumbar disc surgery. *Cochrane Database Syst Rev.* 2014;3:CD003007. Epub 2014 Mar 14.

The purpose of this study was to determine whether active rehabilitation after lumbar disc surgery is more effective than no treatment and which type of active rehabilitation is most effective. In this update to a prior review published in 2002, eight new studies were identified, which included twenty-two new trials with 2503 participants. All patients had undergone a discectomy (standard, microdiscectomy, or laminectomy and discectomy) and the overall mean patient age was 41.4 years. No significant differences were seen between supervised and home exercise programs with regard to pain relief, disability, or global perceived effect. The quality of the evidence was low to very low, but exercise programs starting four to six weeks post-surgery seem to lead to a quicker decrease in disability and pain compared with no treatment. High-intensity programs seem to lead to a slightly faster decrease in pain and disability compared with low-intensity programs.

**Patel S, Friede T, Froud R, Evans DW, Underwood M.** Systematic review of randomized controlled trials of clinical prediction rules for physical therapy in low back pain. *Spine (Phila Pa 1976).* 2013 Apr 20;38(9):762-9.

The purpose of this study was to evaluate randomized controlled trials validating the effects of a clinical prediction rule for physical therapy for nonspecific low back pain. Clinical prediction rules can be beneficial in determining which patients will respond best to specific interventions.

Three studies were included in the systematic review. One study found a greater improvement in the Oswestry Disability Index for patients who were matched into the most appropriate treatment for the subgroup.

Another study found the greatest treatment benefit in patients who met certain criteria prior to treatment. The third study found no interaction between treatment groups and the prediction rule. Overall, the authors found that the evidence validating clinical prediction rules for low back pain is weak.

**Poetscher AW, Gentil AF, Lenza M, Ferretti M.** Radiofrequency denervation for facet joint low back pain: a systematic review. *Spine (Phila Pa 1976).* 2014 Jun 15;39(14):E842-9.

This was a systematic review and meta-analysis of randomized controlled trials to assess the treatment effects (both the benefits and harms) of radiofrequency denervation for patients with facet joint-related chronic low back pain. Fifteen studies were selected, and, of these, nine were appropriate, but the evidence was rated as low to moderate. The evidence shows that radiofrequency denervation of facet joints is more effective than placebo in functional improvement and pain control and possibly more effective than steroid injections in pain control. There was not sufficient reporting of adverse effects and complications to allow for comparisons and there was no evidence for cost-effectiveness.

**Roh GU, Yang SY, Shim JK, Kwak YL.** Efficacy of palonosetron versus ramosetron on preventing opioid-based analgesia-related nausea and vomiting after lumbar spinal surgery: a prospective, randomized, and double-blind trial. *Spine (Phila Pa 1976).* 2014 Apr 20;39(9):E543-9.

This was a prospective, randomized, double-blinded study to compare the benefits of ramosetron to palonosetron in controlling postoperative opioid-induced nausea and vomiting in patients after lumbar spinal surgery. Ramosetron was superior to palonosetron in terms of reducing the prevalence and severity of nausea associated with intravenous opioids after lumbar spine surgery.

**Song KS, Piyaskulkaew C, Chuntarapas T, Buchowski JM, Kim HJ, Park MS, Kang H, Riew KD.** Dynamic radiographic criteria for detecting pseudarthrosis following anterior cervical arthrodesis. *J Bone Joint Surg Am.* 2014 Apr 2;96(7):557-63.

This was a retrospective review of cervical fusion assessment using dynamic radiographs with CT confirmation. This study concluded that with a magnification of 150% and a good pair of flexion and extension radiographs (defined as one with >4 mm of interspinous process motion), a pseudarthrosis was noted with >1 mm of motion between fused interspinous processes with 96.1% specificity and a positive predictive value of 96.9%.

**Vaccaro A, Beutler W, Peppelman W, Marzluff JM, Highsmith J, Mugglin A, DeMuth G, Gudipally M, Baker KJ.** Clinical outcomes with selectively constrained SECURE-C cervical disc arthroplasty: two-year results from a prospective, randomized, controlled, multicenter investigational device exemption study. *Spine (Phila Pa 1976).* 2013 Dec 15;38(26):2227-39.

The authors showed that SECURE-C was statistically superior in terms of overall success, index-level subsequent surgical procedures, and patient satisfaction compared with anterior cervical discectomy and fusion.

**Verma K, Errico T, Diefenbach C, Hoelscher C, Peters A, Dryer J, Huncke T, Boenigk K, Lonner BS.** The relative efficacy of antifibrinolytics in adolescent idiopathic scoliosis: a prospective randomized trial. *J Bone Joint Surg Am.* 2014 May 21;96(10):e80.

This randomized controlled trial compared the efficacy of intravenous tranexamic acid, epsilon-aminocaproic acid, and placebo to reduce bleeding in 125 patients with adolescent idiopathic scoliosis undergoing posterior fusion. They found less intraoperative and postoperative blood loss and higher hematocrit levels than placebo with use of the antifibrinolytics when arterial blood pressure was <75 mm Hg during exposure. Although a positive trial, the

## WHAT'S NEW IN SPINE SURGERY

study showed only a minimal clinical effect because transfusion requirements were no different between groups.

**Verma K, Gandhi SD, Maltenfort M, Albert TJ, Hilibrand AS, Vaccaro AR, Radcliff KE.** Rate of adjacent segment disease in cervical disc arthroplasty versus single-level fusion: meta-analysis of prospective studies. *Spine (Phila Pa 1976)*. 2013 Dec 15;38(26):2253-7.

The authors performed a meta-analysis of six randomized clinical trials including 1586 patients comparing the rate of adjacent segment reoperation between cervical arthroplasty and fusion after discectomy. They found that the reoperation rate was higher following fusion (6.9%) than arthroplasty (5.1%),

but the difference was not significant. However, any conclusions are limited by poor follow-up and the significant heterogeneity of included studies.

**Villard J, Ryang YM, Demetriades AK, Reinke A, Behr M, Preuss A, Meyer B, Ringel F.** Radiation exposure to the surgeon and the patient during posterior lumbar spinal instrumentation: a prospective randomized comparison of navigated versus non-navigated freehand techniques. *Spine (Phila Pa 1976)*. 2014 Jun 1;39(13):1004-9.

The authors found that radiation exposure to the surgeon during pedicle screw insertion with the freehand technique is up to ten times greater than with the use of navigation.